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CHINA-BUILT AIRBORNE SYNCHRONOUS LASER RANGER

THE NEW L-8 JET TRAINER AIRCRAFT

by

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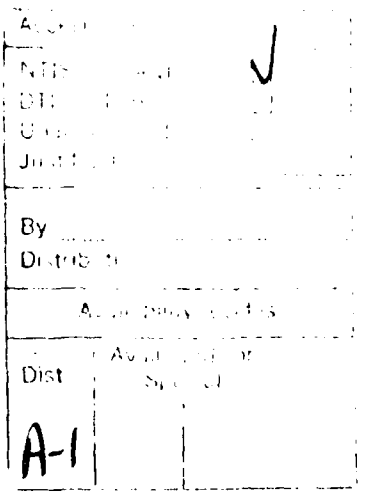

CHINA-BUILT AIRBORNE SYNCHRONOUS LASER RANGER

The synchronous laser ranger developed by Luoyang Electro-Optics Research Institute is presented. It can be used in attackers, bombers, armed helicopters and ground vehicles to improve the attack accuracy of weapon systems.

The airborne synchronous laser ranger designed and built by the China Aviation Technology Import Export Corporation Electrooptics Equipment Research Institute passed flight testing and in September of 1987 were evaluated for design model technology in Luoyang in Honan Province. This ranger is mainly used in attack aircraft for air-to-ground ranging. It provides highly accurate target distance and location information for the fire control systems, improving the firing accuracy of airborne weapons systems. It can also be used in bombers and armed helicopters as well as surface vessels and vehicles for fire control system ranging. It can also be used in combination with aerial cartography, terrain avoidance and terrain following systems.

Research on the airborne synchronous laser ranger began in the early 1980's. There were four stages of research - theoretical experimentation, theoretical models, practical models, and design model. The models which were included in the recent model technology evaluation were tested for technical capabilities against national standards and regulations and environmental suitability, and were tested in flight. These tests all illustrated that this instrument either met or surpassed design requirements for operational stability, proper interface, scope and accuracy of ranging.

repetition frequency and degree of synchronism. After mounting this synchronous laser ranger on an aircraft, the accuracy of its weapons systems improved greatly, especially against targets of uncertain elevation in mountainous terrain, which can be fired upon equally as effectively as targets on level ground.

SYSTEM COMPONENTS AND TECHNICAL CAPABILITIES.

The airborne synchronous laser ranger is composed of the laser transmitter/receiver, the laser transmitter power source, the ranging signal processor, a cooler, and a servo-amplifier. The laser transmitter/receiver components are installed on the underside of the aircraft where they partially extrude. The laser window is exposed to the outside of the aircraft for the laser transmission and reception. The servo amplifier uses the amplified target location information provided by the weapons system computer to drive the optical apparatus and control the deflection of the laser beam, thus sweeping and tracking the target.

The device uses the operation substances of Nd : YAG, the laser wave length is 1.064 microns, the laser repetition frequency is 10 hertz, peak energy is no less than 6 megawatts, and the transmitted laser beam has an angle of divergence of one milliradian. Ranging distance is 150~15000 meters, ranging accuracy is not greater (sic) than 10 meters, laser beam deflection angle is $0\sim12^{\circ}$, synchronous accuracy is 2 milliradians. It is capable of normal operations under temperature conditions of from -45 to +60 degrees centigrade.

TEST RESULTS.

Product use agencies, military representatives and quality inspection agencies conducted various surface tests and design model tests according to the product technical requirements. First, it smoothly passed the technical capability qualification tests and tests at high and low temperatures, for shock, vibration and electromagnetic interference capabilities. Then eight cycles of qualifying tests consisting of 64 individual tests were conducted. Under various borderline conditions the device was operated for more than 150 hours and nearly 60,000 simulated rangings were conducted, smoothly completing the testing required by the program. The test results show that this device works in theory, that it has proper controls, connections and logic. All technical standards tested met the requirements of [Technical Requirements].

Prior to in-flight model testing, the product was tested on the ground for interfacing with other equipment aboard the aircraft and was run through a series of tests with the aircraft on the ground to assess the operational stability, ranging accuracy, and electromagnetic compatibility with the radar, radio, computer, and aiming device aboard the aircraft. The results of these tests show that the device operates in a stable manner, that its electromagnetic compatibility meets the requirements of HB 5662-81, and that the maximum ranging error is six meters.

Design model flight testing was conducted on an attack aircraft between July 1986 and March 1987. A total of 26 sorties were flown, during which the device was operated for a total of 14 hours and was used for ranging a variety of targets under many different flight conditions to determine if the

degree of synchronism of the airborne synchronous laser ranger and the scope of ranging satisfied technical standards. It was also tested to determine if the laser ranger satisfied technical standards for bombing and firing accuracy against targets in mountains and on plains when connected to the fire control system. The results of these tests show that the synchronous laser ranger works very well and that tactical technical indices are all up to design requirements, and some surpassed design requirements. The bombing accuracy was greatly improved after using this device. Statistics from close to 100 bombs show that the deviation along the X and Y coordinates was between two-thirds and three-fourths less than design limits. This completely illustrates that the airborne synchronous laser ranger effectively improves the combat capability of the attack aircraft, and especially against targets in mountainous terrain. This product has widespread applications within fire control systems.

MAIN CHARACTERISTICS.

The airborne synchronous laser ranger which we have developed ourselves has the following main characteristics:

1. LONG RANGING DISTANCE. This ranger uses a small highly efficient solid pulse laser, and when it transmits at over ten joules, the electrooptical exchange is conducted at an efficiency of over one percent. The ranger also uses low-voltage silicon cascade receiver technology which greatly improves the detection sensitivity of the system. Under weather conditions of degree seven visibility, it can detect targets of diffuse reflectance of 0.2 to 0.3 at up to 15,600 meters.

2. HIGH RANGING ACCURACY AND HIGH DEGREE OF SYNCHRONISM. The distance information processor uses precision chronometry, mathematical model conversion, and strict logic control technology. Its ranging accuracy is within five meters for digital output and 10 meters for analogue output. The servoamplifier uses two stage error complexing control technology. It has excellent dynamics and a high degree of synchronism.

3. EXCELLENT ELECTROMAGNETIC COMPATIBILITY. This ranger uses an L-C constant-current charged laser transmitter power source with reasonable counter-ECM measures which greatly reduce the amount of conducted interference and radiated interference. Tests have shown that all requirements for electromagnetic compatibility for use aboard aircraft have been met.

4. GOOD RELIABILITY AND MAINTAINABILITY. The reliability of the ranger was demonstrated and calculated during the design, and measures were taken to resolve all problems with the theoretical models. For example, major components with a high rate of malfunction were reduced to a minimum during design. It was designed so the lamp could be replaced in the field and it has a modular component board which greatly reduces the amount of time required to replace the lamp or to diagnose problems. It uses a reasonable thermal design which ensures the stability of the laser circuit. Therefore, the MTBF value of the device meets the requirements of the connected systems.

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